SUSTAINABLE MEGACITIES:
vulnerability, diversity, and livability

IPB INTERNATIONAL CONVENTION CENTER
Bogor, 17 - 18 March 2015

Center for Regional System Analysis, Planning and Development
Bogor Agricultural University

Office:
Kampus IPB Baranang Siang
Jl. Pajajaran, Bogor 16153
Indonesia
Phone: +62 251 8359 072

- Regional Planning and Development
- Community and Rural Planning and Development
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Proceeding Book

THE 5th INTERNATIONAL CONFERENCE OF
JABODETABEK STUDY FORUM

"SUSTAINABLE MEGACITIES: VULNERABILITY, DIVERSITY AND LIVABILITY"

JABODETABEK 2015

IPB International Convention Center (IICC)
Bogor, Indonesia. 17-18 March 2015

ISBN:978-602-14437-7-4

CREDIT

Proceeding. The 5th International Conference of Jabodetabek Study Forum
"Sustainable Megacities: Vulnerability, Diversity and Livability"

Crestpent Press, Bogor, Indonesia

Editor
Dr. Ernan Rustiadi
Prof. Dr. Shin Muramatsu
Dr. Alinda FM Zain
Dr. Janthy T. Hidajat

Copyeditor
Candraningratri Ekaputri Widodo, PhD
Febri Sastiviani Putri Cantika, S.P.
Novida Waskitaningsih, M.T

Layout and Cover Design
M. Nurdin
Januar Sena

First edition, April 2015

Proceeding. The 5th International Conference of Jabodetabek Study Forum
"Sustainable Megacities: Vulnerability, Diversity and Livability"
Bogor, Crestpent Press, 2015
x + 300 page: x cm

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Center for Regional System Analysis, Planning and Development (CRESTPENT/P4W)
Bogor Agricultural University. IPB Baranangsiang Campus,
Jalan Raya Pajajaran, Bogor 16143, Indonesia
Phone/Fax: +62-251-8359072

Foreword

More than half of the world's population now lives in urban areas. Rapid urbanization in Asian developing countries over the past half century has been followed by excessive urban population concentration in very large urban agglomerations, so called as megacities. The UN defined megacity as a metropolitan area (urban agglomeration complex with more than 10 million inhabitants. The number of megacities in the world has increased from 10 megacities in 1990 with 153 million of population or 7 percent urban population of the world to become 28 megacities in 2014 with 453 million populations or 12 percent urban population of the world. The United Nations expected that by 2050 about 66 percent of the world's population will live in cities (UN, 2014).

The rapid growth, high population density and high consumption rate of residents in megacities has led to a wide range of local and global socioeconomic and environmental impacts which requires attention from the global community. Therefore, it will significantly affect the future prosperity and sustainability of the world. The Greater Jakarta or Jabodetabek is experiencing continuous growth that seems to be an unstoppable phenomenon and at the same is facing various problems that may not have been experienced by other major cities in the world. The result of many studies showed that the carrying capacity of the environment, especially land and water in Java Island where Jabodetabek lies, is already overshot. However, given the relatively rapid growth of Mega Urban Jakarta, it is possible that Jakarta will grow to be the world's largest megacity.

Amid the global concern on the negative impacts of the continuing megacities' growth on global environment, the Center for Regional System Analysis Planning and Development (CRESTPENT/P4W), Bogor Agricultural University (IPB) has established Jabodetabek Study Forum since 2001. This Study Forum has conducted biennial international seminar on complex mega-urban issues on Asian megacities as well as urbanization and urban-rural linkages in Asian countries. The biennial conference has a tradition of organizing two types of paper presentations, namely scientific papers and community papers. This year's conference will also open a session for local government officials. This proceeding book covers papers from nearly all the presentations delivered during the conference.

We hope that this proceeding book will be able deliver the aims of the conference: to recognize multi-dimentional aspects, perspectives and knowledge on megacities; to communicate and facilitate experiences, policies, and studies related to challenges of continuing development of Jabodetabek and Asian Megacities, as well as solutions to address these challenges; and to bring up common understanding on the development of Jabodetabek and Asian Megacities.

Bogor, April 2015

Organizer

Content

Study on Urban Settlement Management in The Central Part of Central Ciliwung Watershed, Bogor

Prita Indah Pratiwi[1)], Debora Budiyono[2)]
[1)] *Lecturer of Landscape Architecture Department, Bogor Agricultural University*
[2)] *Lecturer of Landscape Architecture, Tribhuwana Tunggadewi University*
E-mail: chazter610@yahoo.com, debora_shif@yahoo.com

ABSTRACT

The rapid population growth in Bogor city has implications for the increase of need for shelter. It has encouraged a landuse change in the central part of Central Ciliwung Watershed. The riparian settlement is illegal settlement growing into slum area in the city center. The purpose of this study was to develop a management strategy of ecologically based urban settlement in the central part of Central Ciliwung Watershed. The research was conducted in five stages: preparation and determination of research location, data collection, health and settlement environment identification, SWOT (Strenght, Weakness, Opportunities, Threats) analysis, management strategy formulation. Descriptive quantitative and qualitative method was applied in this research. The results showed that the settlement management in the central part of Central Ciliwung Watershed was progressive strategy. It meant that the existing design was in less stable condition. The main priority of the management strategy in the central part of Central Ciliwung was ecological aspect. The concept of settlement consisted of three zones, namely the housing zone, transition zone, and the public zone. There were 2 types of settlement: middle class and lower middle class settlement.

Keywords: *Ciliwung, Landscape Management, SWOT, Urban Settlement, Watershed*

INTRODUCTION

The collapse of houses along the river in various regions of Indonesia causing the death of residents. Landuse change taken place in riparian areas is made by the housing developers and the poor marginal community. Whereas, riparian areas have a function as a buffer space between the aquatic and terrestrial ecosystem so that the function of rivers and human activities are not disturbed [1]. One of the riparian areas, which have ecological function, is the central part of Central Ciliwung Watershed in Bogor city. However, nowadays the riverbanks in Bogor city have changed in terms of ecological function. Along the riverbank of Central Ciliwung Watershed has been used by lower middle class of residents who have relatively low income. As a result, the environmental condition along the river is not concerned and managed, such as the loss of vegetation component as a supplier of nutrients to fauna component in the river. The existence of this settlement creates the river is not as waterfront or orientation for doing daily activities, but as a household domestic waste disposal at the back of the house. The housing along the river is one of the spontaneous settlements formed from simple initial condition of the physical building [2]. The initial condition of spontaneous settlements formation tends to become a slum house. The characteristics of slum housing as an unstructured housing form, unpattern, no public facilities, poor physical infrastructure and uninhabitable environment (periodically flooded) show the riparian settlement in central part of Central Ciliwung Watershed [3]. If the condition of river bank of central Ciliwung, especially its water resource is not managed, it will cause problems both in terms of environmental spatial quality and public health quality. The determination of the riverbank width is one of the ways to maintain the ecological functions, hydraulic, and morphology of the river [4]. This step needs to be conducted in the riverbank of Central Ciliwung Watershed in order to manage the landscape along the river as one of the alternatives, which could be developed to reduce population density, environmental pollution, and flooding threat. It could increase the ecological functions so that the aquatic, terrestrial, and ecotone

ecosystem could be protected and sustained [5]. The design of the riverbank area should [illegible] geographical factor and urban context underlying the decision and design solution [6]. The purpose of this study was to develop a management strategy of ecologically based urban settlement in the central part of Central Ciliwung Watershed.

RESEARCH METHOD

The study was conducted in the central part of Central Ciliwung Watershed, Bogor, West Java. The location was selected with the existence of dense settlements which might have impact on the watershed ecology (Figure 1, 2, 3, and 4). The width of the central part of Central Ciliwung Watershed Bogor is [illegible] hectares with the number of population of 87.846 people (Table 1).

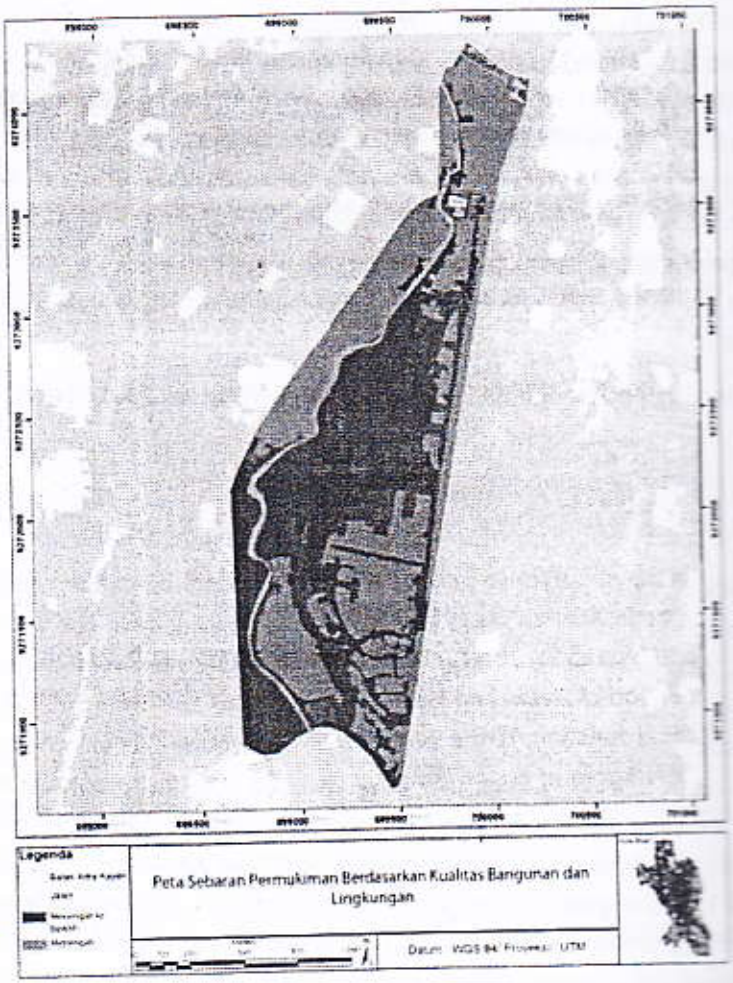

Figure 1. Ciliwung Watershed Land Use Map
(Source: *Budiman*, 2012)

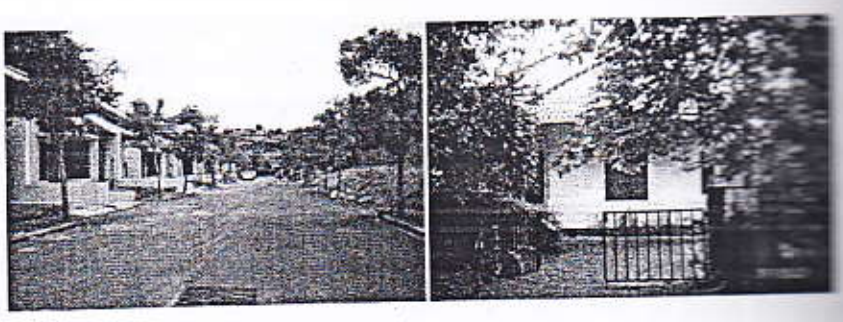

Figure 2. The Existing Middle Class Housing
(Source: *Budiyono and Pratiwi*, 2012)

Figure 3. The Existing Lower Middle Housing
(Source: *Budiyono and Pratiwi*, 2012)

Figure 4. Existing Models of Central Ciliwung Watershed Housing, Bogor
(Source: *Budiyono dan Pratiwi*, 2012)

Table 1. Width Area and The Number of Residence

District	Village	Width (Ha)	Number of Residence (people)
Central Bogor	Sempur	63	7,829
Central Bogor	Pabaton	72	3,719
Central Bogor	Babakan	128	6,039
North Bogor	Bantarjati	183	22,339
North Bogor	Cibuluh	194	17,623
Tanah Sareal	Kedung Badak	219	21,786
Tanah Sareal	Tanah Sareal	155	8,511

(Source: *Budiman*, 2012)

The methods used in this study were survey and literature study. The research stages were (1) preparation and determination of the location for observation of the physical aspects of housing and the environment, (2) primary and secondary data collection, (3) identification of health and housing environment [7], (4) SWOT analysis (*Strenght, Weakness, Opportunities, Threats)* [8], and (5) management strategy of sustainable settlement. The data analysis method used was qualitative and quantitative data analysis. Qualitative data analysis was analysis of the internal and external factors, whereas quantitative analysis was conducted by weighting and giving rating. The SWOT analysis stages as follows [9]:

1. Identification of Internal Factor (IFE) and (EFE) External Factor and Significance Level Determination (Table 2 and Table 3).

Table 2. Significance Level of Internal Factor (IFE)

Symbol	Strength Factor	Significance Level	Rating
S1			
S2			
Sn			
Symbol	**Weakness Factor**	**Significance Level**	**Rating**
W1			
W2			
Wn			

(Source: *Rangkuti*, 1994)

Table 3. Significance Level of External Factor (EFE)

Symbol	Opportunity Factor	Significance Level	Rating
S1			
S2			
Sn			
Symbol	**Threat Factor**	**Significance Level**	**Rating**
T1			
T2			
Tn			

(Source: *Rangkuti*, 1994)

Each factor would be given the level of significance ranging from very important to not important as well as rating scale of 1 to 4 with the following ratings (Table 4):

Table 4. Significance Level Rating of Internal (IFE) dan External (EFE) Factor

valuei	IFE matrix		EFE matrix	
	Strength (S)	Weakness	Opportunity	Threat
1	Very small strength	Very big weakness	Low opportunity	Very big threat
2	Moderate strength	Big weakness	Moderate opportunity	Big threat
3	Big strength	Moderate weakness	High opportunity	Moderate threat
4	Big strength	Small weakness	Very big opportunity	Small threat

(source: *Rangkuti*, 1994)

2. The Weighting Determination of Internal and External Factor

   Weighting was conducted by giving weight assessment of internal and external factors with the following conditions:

   a. horizontal factor indicator is less important than the vertical factor indicator, weight = 1
   b. horizontal factor indicator is equally important than the vertical factor indicator, weight =2
   c. horizontal factor indicator is more important than the vertical factor indicator, weight = 3
   d. horizontal factor indicator is very important than the vertical factor indicator, weight = 4

The weight of each variable was obtained by determining the value of each variable to the overall variable using the formula below [9]:

$$a_i = \frac{X_i}{\sum_{i\,1}^{n} X_i}$$

Notes:
ai = weight of*i*variable
xi = value of *i* variable
i = 1,2,3,...,n
n = number of variable

Having weighted, total value weighting was calculated by multiplying each weight with the rating of each internal and external factor (Table 5 and Table 6).

Table 5. Determination of Total Weighting Score of Internal Factors (IFE)

Symbol	S1	S2	Sn	W1	W2	Wn	Total	Weight	Rating	Score
S1										
S2										
Sn										
W1										
W2										
Wn										
	Total									

(Source: *Rangkuti*, 1994)

Table 6. Determination of Total Weighting Score of External Factors (EFE)

Symbol	O1	O2	On	T1	T2	Tn	Total	Weight	Rating	Value
O1										
O2										
On										
T1										
T2										
Tn										
	Total									

(Source: *Rangkuti*, 1994)

If the total value of IFE and EFE is more than 2.5, the value indicates strong condition. This could be mapped through IFE and EFE matrix which could be seen in Figure 5.

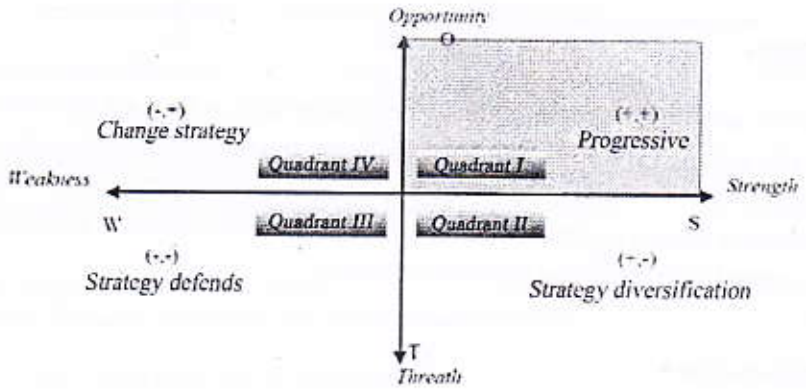

Figure 5. IFE and EFE Matrix
(Source: *Rangkuti*, 1994)

3. Formulation of strategy and priority *(ranking)*
   Based on the matrix above, the appropriate strategy was obtained and incorporated into the SWOT matrix (Table 7).

Table 7. Formulation of Strategy through SWOT Matrix

External / Internal	Opportunity	Threat
Strength	SO Strategy Utilize all of the strengths to take and use the opportunities as possible	ST Strategy Use the strengths to overcome the threats
Weakness	Strategy WO Based on the use of opportunities by minimizing the existing weaknesses	Strategy WT Based on the defensive activities by minimizing the weakness and avoiding the threats

(Source: *Rangkuti*, 1994)

Based on the analysis, the management development of program strategy was obtained with its priority level (Table 8).

Table 8. Program Priority of Management Development

No	Alternative strategy	Linkage of SWOT elements	Score	Ranking
1				
2				
3				

(Source: *Rangkuti*, 1994)

The SWOT analysis results was derived into the criteria of management strategy in order to obtain a standard or criterion to establish housing in other watershed areas. The criteria concept are arranged in a criteria matrix in which the indicators in formulation of housing strategy in the central part of Central Ciliwung Watershed (Table 9).

Table 9. Criteria Matrix of Urban Riparian Settlement Management

No	component (priority)	weight	design criteria of riparian settlement		
			1	2	3
1	Component 1				
	Variable 1				
2	Component 2				
	Variable 2				
N	Component n				
	Variable n				

(Source: *Rangkuti*, 1994)

The criteria obtained were organized into three criteria classifications through assessment: low score (1), moderate score (2), and high score (3). The score indicated the fulfillment to the criteria for settlement management strategy in the central part of Central Ciliwung Watershed. Classification criteria for low, medium, and high were applied in settlement management strategy in order to gain scenario in managing settlement in the central part of Central Ciliwung watershed.

RESULTS AND DISCUSSION

Identification of health requirements for housing and settlement

Condition of housing and settlement environment as well as its assessment were clearly stated in Decree of Health Ministry Republic of Indonesia Number 829/Menkes/SK/VII/1999 [7] and Decree of Public Housing Ministry Republic of Indonesia Number 4/KPTS/BKP4/1995 [10]. People agree that housing is a prerequisite for mental health although it is difficult to prove the relationship [11 The location of the central part of central Ciliwung Watershed settlement did not conform with the standards because it was located in prone natural disaster area due to landslides located at <5 m from the river bank with fairly good air and soil quality and noise <55 dBA. The settlement has the facilities and infrastructure as follows:

a. Playground at school, neighborhood parks
b. Drainage with a clean condition and good flow,
c. Street lighting, no sidewalks and safety fences,
d. Communal clean water source from springs in park and individual clean water from PDAM
e. Communal water closet in each neighborhood (4 units) and private water closet in middle-class homes,
f. The trash in every home without garbage separation, behavior of throwing garbage into river still found
g. Health care facilities such as Posyandu in each village, a public phone in a few neighborhood, accessibility in the West side of the settlement is quite difficult because it could use suspension bridge with a width of <1 m, entertainment venue such as Sempur park, school in East side of settlement,
h. Electrical installation using the PLN
i. Quite good food management

Elephantias is disease vector through mosquito larvae index was less than 5 percent. Greening in middle class settlement was characterized by the presence of the park at least 40 percent of building area, while the lower middle class settlement almost has no garden. Lower middle-class settlement has a building

area of 48 m2, while the middle-class settlement (150 m2) was in line with the standards of building area of 70-150 m2.

SWOT Analysis of Management Component

The following table is a grouping of internal and external factors in the management of settlements in the central of Central Ciliwung Watershed.

Table 10. Importance Level of Internal Factors in The Central Part of Central Ciliwung Watershed Management

Importance level of internal factors			
SYMBOL	*FACTORS OF STRENGHT*	IMPORTANCE LEVEL	SCORE
Location S1	Not located in the former landfills area or former mining and fire-prone free	Very big strength	4
Air Quality S2	Do not contain toxic gases	Very big strength	4
Noise and Vibration S3	Noise and Vibration < 55 dBA		3
Environmental Infrastructure and Facilities S4	Playground for children, sports facilities, and family recreational facilities	Moderate Strength	2
S5	Drainage with clean and good condition	Very big strength	4
S6	Roads (suspension bridge) which has a safety rail and street lighting	Very big strength	4
S7	Communal: water spring from the Peranginan Park	Very big strength	4
S8	Communal: water closet 4 units in each neighborhood Individuals: private water closet (middle-class settlement)	Very big strength	4
S9	Trash bin in every house and have a garbage dump in several village	Very big strength	4
S10	Access to health care facilities, communications and education	Very big strength	4
Greening S11	Garden with the size at least 40 percent of the total building area in middle-class settlement has	Big strength	3
SYMBOL	*FACTORS OF WEAKNESS*	IMPORTANCE LEVEL	SCORE
Location W1	Not river oriented settlement and located in disaster-prone areas	Big weakness	2
Environmental Infrastructure and Facilities W2	Insufficient drainage width	Very big weakness	1
W3	Roads with slope ± 45 percent, do not have sidewalks and safety fence	Very big weakness	1
W4	Direct waste disposal into river	Very big weakness	1
W5	No waste separation and throwing garbage behavior into the river	Big weakness	2
W6	Accessibility of vehicles is quite difficult, road width <1 m (settlement in West side), 5 m (settlement in East side)	Very big weakness	1
W7	No art studio	Moderate weakness	3
W8	Raising fish in cages (keramba) with food from inorganic chemicals	Big weakness	2
Vector-borne Diseases W9	Mosquito larvae index: elephantiasis	Moderate weakness	3
Greening W10	Lower-class settlement almost does not has a garden	Moderate weakness	3

(Source: *Budiyono and Pratiwi*, 2012)

Table 11. Importance Level of External Factors of Ciliwung Watershed Management

Importance level of External Factors			
SYMBOL	*FACTORS OF OPPORTUNITY*	IMPORTANCE LEVEL	SCORE
Environmental Infrastructure and Facilities			
O1	Individual: local water company (PDAM)	Very big opportunity	4
O2	Electrical installation settings: PLN	Very big opportunity	4
SYMBOL	*FACTORS OF THREAT*	IMPORTANCE LEVEL	SCORE
Vektor Penyakit			
T1	Mosquito larvae index: elephantiasis	Moderate threat	3

(Source: *Budiyono and Pratiwi*, 2012)

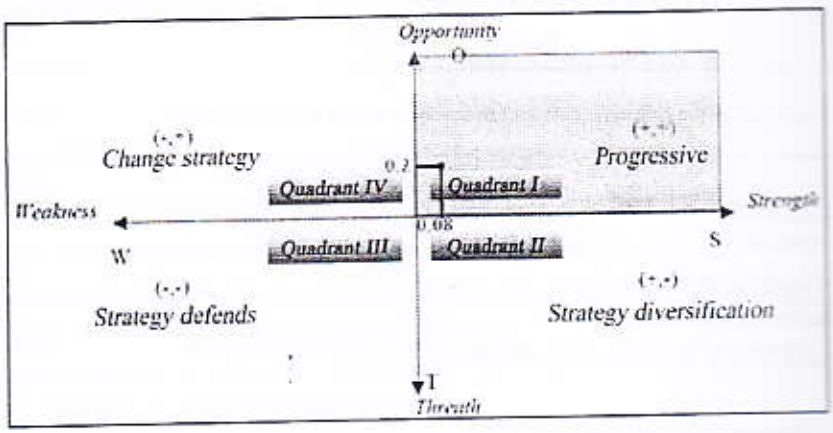

Figure 6. Quadrant Matrix of SWOT Method in the Central Part of Central Ciliwung Watershed Management
(Source: *Budiyono and Pratiwi*, 2012)

The results showed that the total score for the internal factor was 0.08, while the external factor was 0.2. Based on the value of the IFE and EFE, they were mapped into quadrants matrix of SWOT to determine the appropriate strategy. An appropriate strategy for managing the central part of Central Ciliwung Watershed located in the first quadrant was a progressive strategy. It meant that the existing design was in less stable condition, but this design will experience serious challenges from the environment to continue if it only rely on the previous strategy (Figure 6). Recommended strategies were scored and ranked into alternative strategies (Table 11).

Table 12. Priority of Alternative Management Strategies

No	Alternative Strategy	The linkage element of SWOT	Score	Rank
1	Ecological-based management of riparian settlement	S1, S2, S3, S5, S7, S8, O1	1.79	1
2	Infrastructure and facility development on each municipality (drainage, roads, bridges, water closet, water, trash bin, health care, communication and education)	S4, S6, S7, O2	1.36	4
3	Closed drainage arrangement according to standards of healthy housing, placement of water closet in every home away from the river >15 m	S1, S5, S8, S9, T1	1.43	3
4	River oriented settlement arrangement following topography	W1, W3, W6, W8, O1	1.36	4
5	Arrangement of infrastructure and facilities supporting the distribution of water resources (PDAM) and electricity (PLN)	W2, W3, W4, W6, W7, O2	1.07	7
6	Utilization of open space as a neighborhood park and the art studio to improve air quality	W7, W10	1.29	2
7	Placement of water waste management installation in each neighborhood and spraying houses regularly	W1, W4, W8, T1	1.07	7

(Source: *Budiyono and Pratiwi*, 2012)

The component of riparian settlement had low, medium, and high score visualized in concept figure in order to obtain an arrangement model. The concept of settlement consisted of three zones, namely the

housing zone, transition zone used for centers of economic activity, and the public zone which used as a recreation place. The empty space among each other villages used as green open space. There were two classes of settlement, namely middle class settlement, and lower middle class settlement (type 1,2, and 3).

Middle Class Settlement

The existing settlement was categorized into formal settlement consisting of official developed housing of KODIM AD, My Residence [12]. The first model was a middle-class settlement with building area of 70-150 m^2 and land area 90-150 m^2 located on river border line distance more than 5 m (Figure 7). Figure 8 showed that the main priority in developing ecologically-based housing design were using traditional-modern form [13]. Settlement arrangement followed the topography and river flow linearly with grid pattern. It was in line with the statement [14] that riparian settlement design has two important aspects that underlie the decisions and design solution, namely geographic context (land condition, climate) and urban context (user, historical-cultural repertoire, accessibility and circulation, visual character). Neighborhood garden was located in the central of the settlement surrounded by facilities and infrastructure supporting the settlements and community's activity. Besides of that, this model have to be able to facilitate local people's habbit such as by providing facility and infrastructure: electricity, drainage, sufficient clean water, washing closet (3x4 m2) > 5 units/neighborhood, communal and individual disposal and municipal waste water treatment system, educational facilities (kindergarten, elementary school), worship facilities, medical facilities, government services (neighborhood office: RT/RW), commercial services (shops, stall), art and cultural studio. Moreover, it required continuous socialization through public policy and law enforcement so that communities could perform their participation by maintaining the facilities [15].

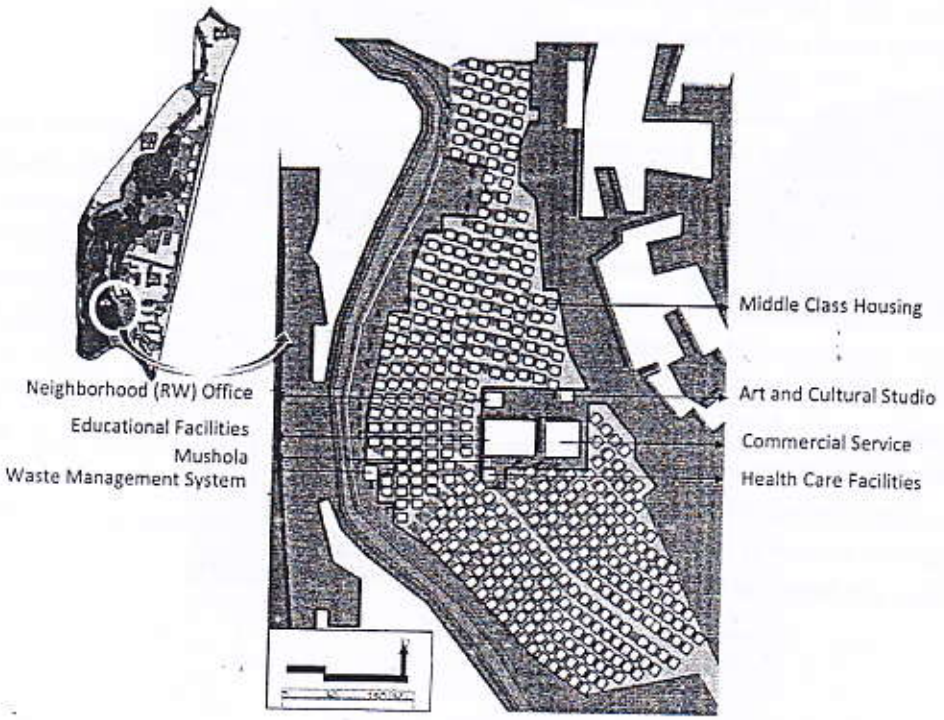

Figure 7. Middle Class Settlement Model
(Source: *Budiyono and Pratiwi*, 2012)

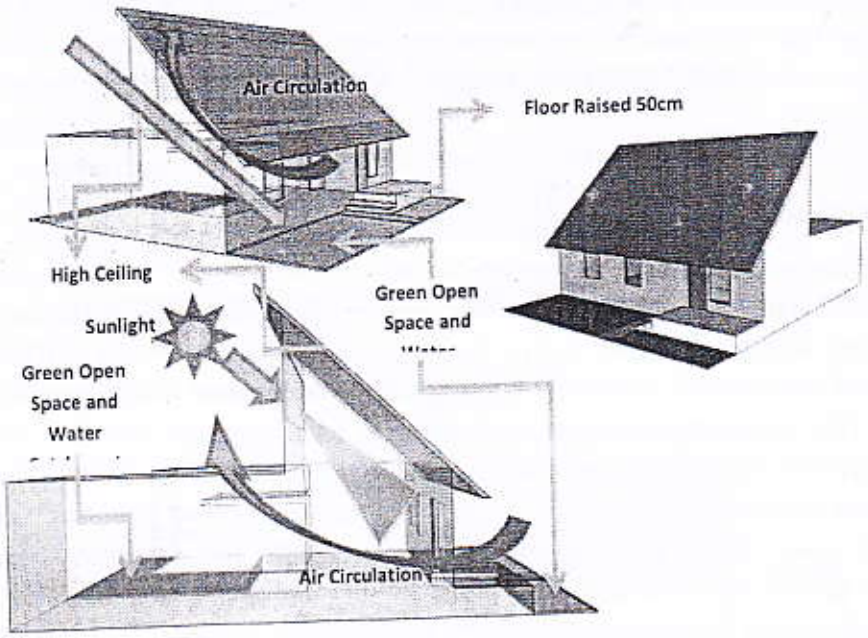

Figure 8. 3D Model of Middle Housing
(Source: *Artha and Wibisono*, 2012)

Lower Middle Class Settlement

The existing settlement was cetogorized into spontaneous settlement formed with very simple building [16], unstructured form, no pattern, minimal public facilities, poor infrastructure and facilities, uninhabitable environment [17], no green open space, almost no building permit. Based on standards of Law Number 4 Year 1992 [18], the lower middle settlement in the central part of Central Ciliwung Watershed was divided into 3 types of models, as follows:

Type 1

The lower middle class settlement type 1 on the West side was river oriented settlement with grid pattern to adjust the very steep slope so that every row of houses have different heights, facilitate the circulation of people, vehicles, and air/wind, river border line distance more than 5 m, and could optimize the capacity of narrow area (Figure 9). The settlement consisted of facilities and infrastructure, such as single house type with building area of 36-70 m^2 and land area of 50-90 m2 inhabited by 5-6 people/house, neighborhood-scale government facilities, neighborhood health center (posyandu), kindergarten, mosque, art studio facilities, security (poskamling), school, neighborhood parks with a size of 50 m2, circulation steps with a width of 2 m, 5 units of water closet/neighborhood, street lights in every home, closed drainage system, trash bin with organic and inorganic waste sorting system in every home. Figure 10 showed the ecologically-based lower middle class housing model using traditional-modern form [13]. Circulation consisted of a two-way circulation using steps with a width of 5 m and green space corridor on the both sides (trees and flowering shrubs), and pedestrian path with a width of 2 m.

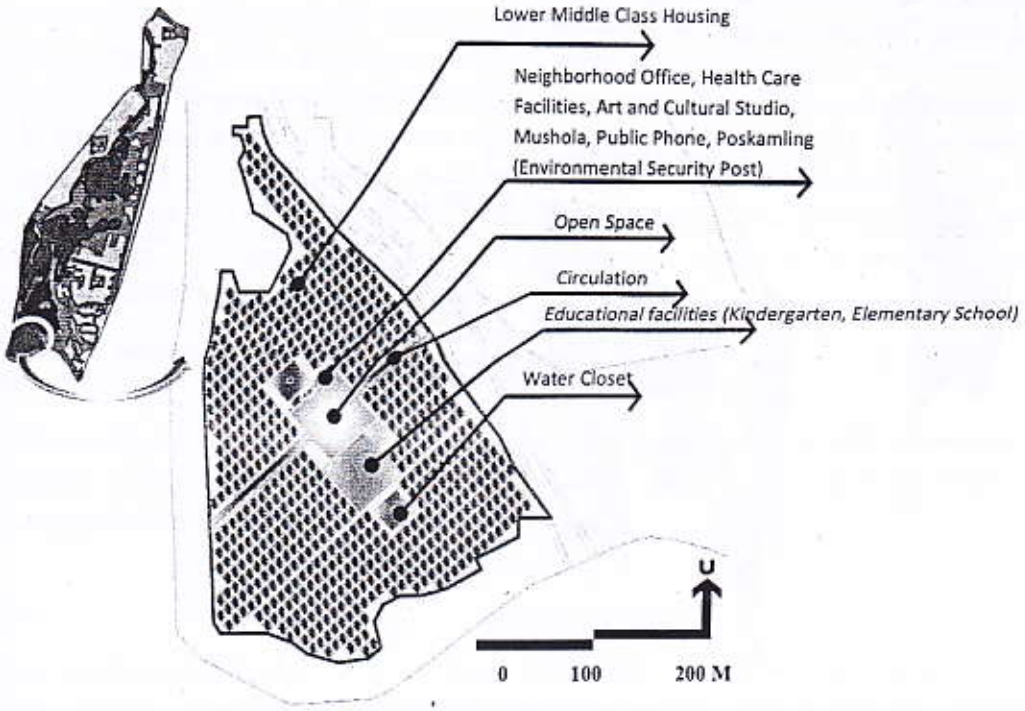

Figure 9. Lower Middle Class Settlement Model Type 1
(Source: *Budiyono and Pratiwi*, 2012)

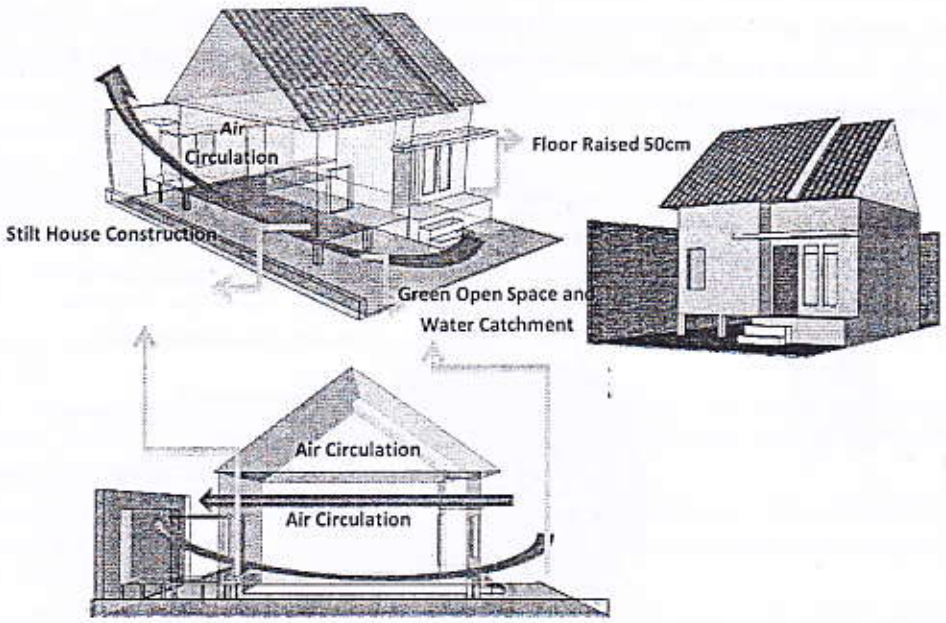

Figure 10. 3D Model of Lower Middle Class Housing
(Source: *Artha and Wibisono*, 2012)

Type 2

This type of settlement model was located in West and East side (Figure 11). The settlement in the West side had a very steep slope, while in the East side tended to be flat. The settlement pattern of this type was similar to the first type. The significant differences with the first type was the layout of open space in which the West side of this type was right on the riverbank with a smaller size than the first type. The West side settlement did not have education facilities because the area was inadequate and located in the same neighborhood (RW) with the East side. There was a suspension bridge as a link between both

sides of settlements so that students could go to school to the East side using the bridge. Facilities and infrastructure of this type were the same with the first type.

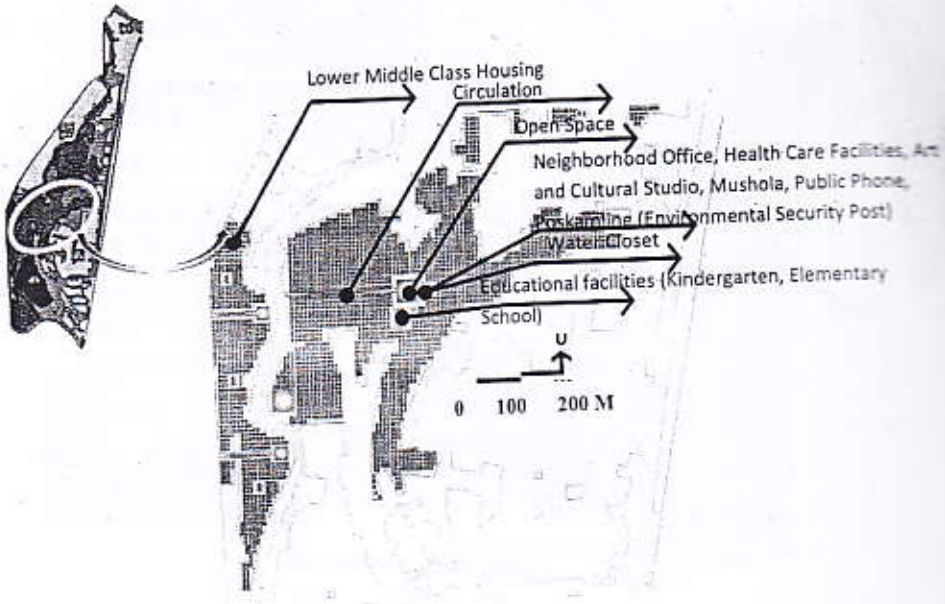

Figure 11. Lower Middle Class Settlement Model Type 2
(Source: *Budiyono and Pratiwi*, 2012)

Type 3

This type of settlement model was located in East side (Figure 12). The settlement pattern of type was similar to the first and second type, this type has similarity with the East side of type 2 in which the slope tends to be flat. Facilities and infrastructure in the settlement of this model was also the same with the previous lower middle settlements.

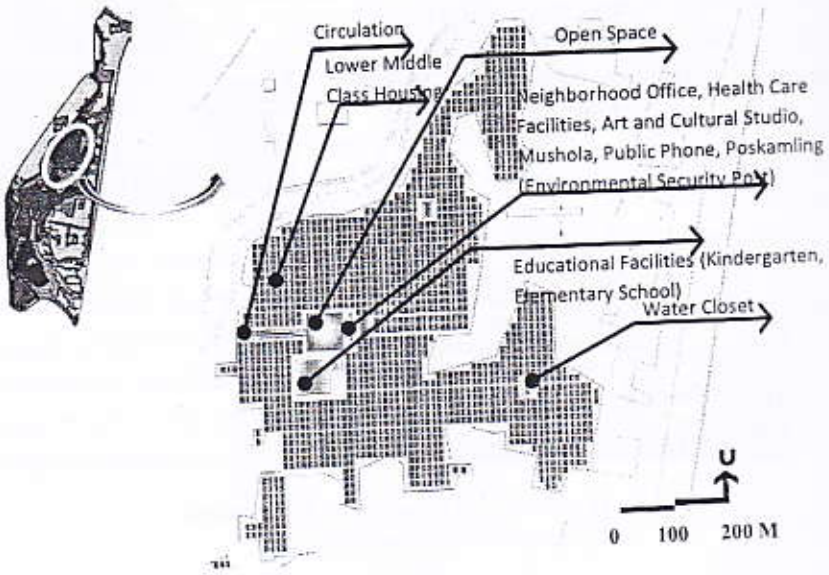

Figure 12. Lower Middle Class Settlement Model Type 3
(Source: *Budiyono and Pratiwi*, 2012)

CONCLUSION

Settlement management of the central part of Central Ciliwung Watershed located in the first quadrant of SWOT is progressive strategy. It means that the existing design is in less stable condition, but this design will experience serious challenges from the environment to continue if it only rely on the previous

strategy. Seven strategic priorities in managing urban riparian settlement are ecological-based management of riparian ecological settlements, infrastructure and facility development on each municipality (drainage, roads, bridges, water closet, water, trash bin, health care, communication and education), closed drainage arrangement according to standards of healthy housing, placement of water closet in every home away from the river >15 m, river-oriented settlement arrengement following topography, infrastructure and facilities arrangement supporting the distribution of water resources (PDAM) and electricity (PLN), Utilization of open space as a neighborhood garden and the art studio to improve air quality, and placement of water waste management installation in each neighborhood and spraying houses regularly.

ACKNOWLEDGEMENT

We would like to thank to Prof. Dr. Ir. Hadi Susilo Arifin, MS and Dr. Syartinilia, SP, MSi who supported and gave suggestion for this research. We also would like to thank to the community in the central part of Central Ciliwung Watershed for the site information.

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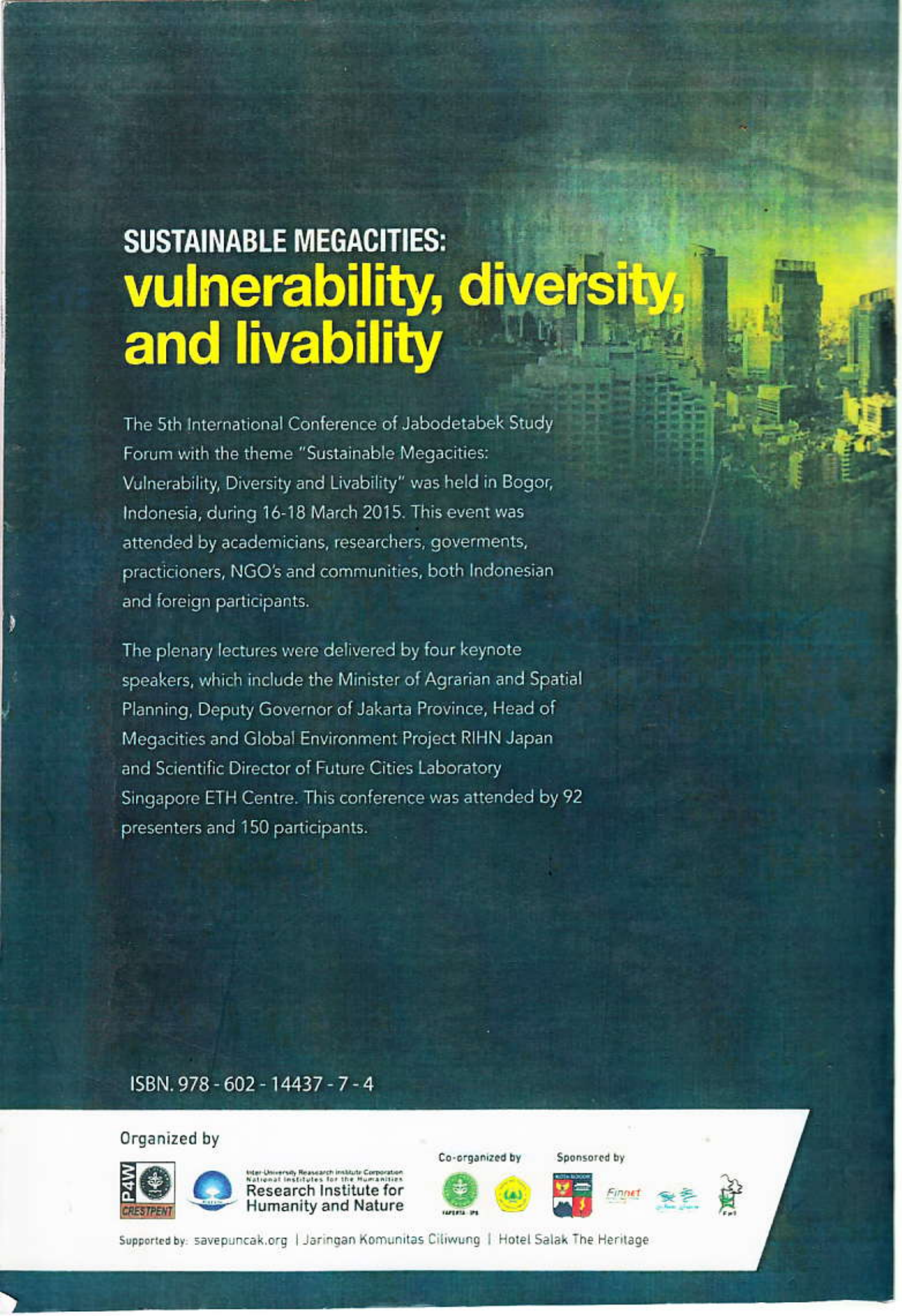

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vulnerability, diversity, and livability

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The plenary lectures were delivered by four keynote speakers, which include the Minister of Agrarian and Spatial Planning, Deputy Governor of Jakarta Province, Head of Megacities and Global Environment Project RIHN Japan and Scientific Director of Future Cities Laboratory Singapore ETH Centre. This conference was attended by 92 presenters and 150 participants.

ISBN. 978 - 602 - 14437 - 7 - 4

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